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Cognitive functional therapy (CFT) based rehabilitation improves clinical outcomes in UK military personnel with persistent low back pain.

ABSTRACT

Introduction: Low back pain (LBP) has been reported as the most common reason for presentation to the Medical Centre in the British Military, and the most common re-referral for the same condition. In 2015, the UK Defence Medical Rehabilitation Centre (DMRC) adopted a cognitive functional therapy (CFT) approach to spinal rehabilitation in line with NICE and military best-practice guidelines. The aim of this study is to evaluate the functional and psychosocial outcomes of all chronic LBP patients treated with CFT-based multidisciplinary rehabilitation at DMRC, Headley Court.

Methods: A prospective observational service evaluation of British Military patients (n=238) with LBP who attended 3-weeks inpatient multidisciplinary CFT-based programme from 2015 to the end of 2017 at DMRC were analysed. Functional outcomes include: Multi-Stage Locomotion Test (MSLT) and sit and reach test. Psychosocial outcomes include: Tampa Scale of Kinesiophobia (TSK), Oswestry Disability Index (ODI), Brief Pain Inventory (BPI), General Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9. **Results:** There were significant improvements in endurance (MSLT), range of motion, kinesiophobia, pain related lifestyle interference (BPI-Lifestyle), anxiety and depression ($p \leq 0.001$). However, no improvements in pain intensity (BPI-Intensity) were demonstrated ($p > 0.05$). **Conclusion:** After 3-weeks of CFT-based multidisciplinary rehabilitation, function and psychosocial health improved with symptoms of pain being less obtrusive to activities of daily activity. There were however no patient-reported reduction in pain intensity. The improvements demonstrated are indicative of outcomes that facilitate greater integration back to work or into society.

Key Messages

- 1) Cognitive functional therapy (CFT) is a patient-centred approach that can be successfully implemented into a residential multidisciplinary team (MDT) clinical setting.
- 2) After 3-weeks, CFT-based multidisciplinary rehabilitation improved cognitive, psychological, and function health without detriments in pain intensity.
- 3) Up to 25 hours per week of appropriate graduated functional exercise rehabilitation did not result in increased pain intensity.
- 4) Despite no reduction in pain intensity, improved function and psychosocial health may be indicative of outcomes that facilitate greater integration back into work or society.

- 5) CFT is effective in the management of persistent non-specific low back pain in UK military.

INTRODUCTION

Low back pain (LBP) is the leading cause of disability and work absenteeism worldwide[1]. The most recent World Health Organization (WHO) Global Burden of Disease study reported low back pain (LBP) as the leading cause of years lived with disease[2]. Approximately 7% of the UK adult population have been estimated to present to their General Practitioner (GP) with LBP costing the National Health Service (NHS) more than £1 billion annually[2, 3].

There is a high prevalence of back pain within military personnel and this often presents as persistent non-specific LBP (NSLBP)[4]. Over a 3 year duration at one UK garrison, LBP was the most prevalent cause for medical referral (22%) and re-referral for the same condition[5]. All LBP referrals at this garrison amounted to 23% of the overall physiotherapy and rehabilitation workload. Treatment approaches offered widely by healthcare professionals typically include education, exercise, core stability, acupuncture, taping, electrotherapy, soft tissue techniques and manipulation. Unfortunately, beyond the subacute stage of low back pain, it is possible that such oriented treatment may promote fear avoidant behaviour and negatively affect functional ability[6].

The last decade has seen an evolution in the management of NSLBP, with a growing evidence base supporting the assessment and treatment of cognitive, psychological, and movement factors[7, 8]. In November 2014, the Defence Medical Rehabilitation Centre (DMRC) Headley Court, Centre for Spinal Rehabilitation, re-structured their programme from a trunk stabilisation rehabilitation approach to what is now considered a cognitive functional therapy (CFT) based model in line with Defence Best Practice Guidelines. This approach has since been included in the current Low Back Pain and Sciatica NICE guidelines for persistent cases[9]. Cognitive functional therapy (CFT) is a patient-centred approach for the management of complex and challenging persistent NSLBP cases. This rehabilitation approach is comprised of pain education, addressing maladaptive movement behaviour, functional integration of activities feared or avoided, and individualised physical exercise[7]. Studies have since demonstrated more superior clinical outcomes using CFT approach over conventional treatment[7, 8].

In January 2015, a prospective review of all chronic NSLBP patients admitted for 3 weeks of CFT based inpatient rehabilitation at the spinal rehabilitation centre at DMRC began. To our knowledge, no CFT-based NSLBP intervention studies have investigated ambulatory function, in addition to range of movement and patient-reported psychosocial outcome measures. The aim of this study is to evaluate the clinical outcomes recorded at admission and discharge.

METHOD

Study Population and Spinal Rehabilitation Pathway

Patients were serving members of the British armed forces with persistent LBP who followed the Defence Medical Rehabilitation Pathway (DMRP) (see figure 1). Patients were admitted to DMRC with symptoms of chronic LBP (> 12 months) with or without associated radicular symptoms. No exclusion criteria based on injury diagnosis was used, therefore a combination of post-surgical and non-surgical, operational and non-operational related back pain were included for analysis. Patients completed an intensive 3-week residential rehabilitation admission incorporating the primary course format with additional one-to-one sessions with MDT staff on a case-by-case basis directed by the clinical lead (see Table 1). The course content is aimed at educating the patient, improving confidence, restoring functional movement patterns and improving activity levels alongside identifying occupational and life goals. Education supports reconceptualising pain, and making sense of peripheral/central sensitization and neuroplasticity.

Table 1. Residential multidisciplinary team (MDT) spinal rehabilitation programme

Treatment type	Description	Therapy Goal	Duration (Frequency)
Gym based group exercise therapy	Fascial mobility, foam rolling, fundamental functional strength, mat based strengthening, low level circuits, Yoga, and CV training.	Develop concept of progressions and regressions to self-manage intensity. Restore movement pattern. Promote confidence in movement.	30,45, or 60 mins (10 per week)
Aquatic based group exercise therapy	Hydrotherapy mobility, movement restoration, and relaxation/ breathing techniques. Swimming with back pain lessons, aqua jogging, pool circuits, pool sports and games.	To utilise the properties of hydrotherapy, particularly heat and reduced weight bearing. Focus on relaxing, whilst graduating available range of movement. Swim lessons focus around better equipping the patient to continue swim based activity.	30 or 45 mins (11 per week)
Informative group lectures	Rehabilitation goal setting, understanding pain, living with pain, functional posture, nutrition, and sleep hygiene.	Lectures are designed to be appropriate for patients unfamiliar with topic. All lectures are intended to be interactive, and offer time for questions.	30 or 45 mins (5 per week)
Recreational therapy/group guided relaxation	Adapted games/potted sports e.g. balance basketball shoot, swiss ball cricket, med ball boules. Guided floor based group relaxation/mindfulness. Instructor led Thai Chi in hydrotherapy pool.	An opportunity to break from the focus of rehabilitation, whilst continuing to promote movement/confidence to move. Distraction by safe competitive environments can present an opportunity to graduate movement e.g. reduce walk aids. Guided relaxation at the end of the day is aimed at managing general pain, although also particularly aimed at patients with high anxiety scores (GAD-7).	30 or 45 min (5 per week)
Individualised exercise programme (IEP)	An IEP is specific to the patient's rehab requirements and is developed by the input of ERI and Physiotherapist. It is normal for the IEP to be modified throughout the programme.	Designed for the patient to take away from the programme, and continue to use until reviewed in the future. The intention is to improve confidence, and encourage the patient to become independent with their daily rehabilitation.	60 min (3 per week)
1:1 Physiotherapy/ Occupational Therapy (OT)	Physiotherapy and OT 1:1 treatment typically utilises private clinical space. A thorough initial 1:1 assessment/interview will govern the 1:1 treatment plan. Patient education is central to 1:1 sessions.	The 1:1 treatment is intended to compliment the rehabilitation programme. Physiotherapy will focus on individual education, and self-managing pain, but also may include manual techniques, acupuncture, taping etc. The OT 1:1 utilises a biopsychosocial approach to improve their functional performance, in personal & domestic activities of daily living, productivity and leisure.	As required
Supplementary Clinical input	Other Clinical Professionals at DMRC may be recruited in for specialist roles within a patient's rehabilitation programme (Pain Consultant, Pain Psychologist, Pain Nurse, Community Psychiatric Nurse, Vocational OT, Social Worker, and Dietician).	Specialist roles will be required to specifically compliment the rehabilitation programme, and their input is intended to improve the overall outcome of the rehabilitation programme for the patient.	As required

Study Design

A prospective observational cohort study as part of a clinical service evaluation was conducted using electronic data collected from the Defence Medical Information Capability Programme (DMICP) from January 2015, to end of 2017. On admission, patients completed a battery of self-reported outcome measures and participated in functional assessment tests. Patients were exempt from functional assessment tests if there were clinical contraindications including medical illness, severe increase in back pain and symptoms of Cauda Equina Syndrome. Only patients with both admission and discharge data available were included for analysis.

Functional and Psychosocial Outcome Measures

Functional measures

The Multi-Stage Locomotion Test (MSLT) is a validated outcome measure of ambulatory function, and has been utilised in spinal rehabilitation as well as other clinical settings[10]. Participants are required to walk/run on a 20 metre track gradually increasing speed until they were unable to continue. Speed was controlled by paced-auditory cues accompanied by verbal instructions. Total distance covered in metres was recorded.

The sit and reach test measures maximal trunk flexion whilst maintaining full knee extension in sitting[11]. The test measures functional flexibility as well as confidence to bend. The patient is required to sit in front of a purpose-built device, with soles of the feet flat against a starting plate. The test is scored as the distance achieved from the fingertips and the toes. Positive scores are achieved when reached beyond the toes, and negative scores are awarded if the patient did not reach beyond toes. The patient repeats the test 3 times with the mean score recorded.

Reported Pain and Disability Measures

The Tampa Scale of Kinesiophobia (TSK) is a self-reported measure of fear of movement. The 17 item TSK Likert scale checklist is reliable for use with patients with chronic back pain[12]. A score of > 37 indicates a presence of kinesiophobia, whereas a score of ≤ 37 indicates no kinesiophobia. The Oswestry Disability Index (ODI) is a patient reported measure of back pain specific disability[13], based upon 1 item of pain, and 9 items specific to activities of daily living, resulting in a maximal score of 100%. The Brief Pain Inventory (BPI) is a self-reported measure of pain intensity and lifestyle interference and is specific to seven areas of function by a scale of 0 to 10, with a score of 0 indicating 'no pain/interference' and 10 indicating the 'worst pain imaginable/complete lifestyle interference'. BPI has been validated and shown reliability in chronic LBP[14].

Psychosocial Measures

The General Anxiety Disorder-7 (GAD-7)[15] and Patient Health Questionnaire (PHQ-9)[16] are two validated patient reported questionnaires that measure anxiety and depressive symptoms, respectively. GAD-7 is scores on a scale of 0 to 21 and PHQ-9 0 to 27.

Data Analysis

The differences between comparable mean scores will be computed, and then a Kolmogorov-Smirnov test will be conducted to assess the normality assumption ($p > 0.05$). In the consequence of non-parametric data, a Wilcoxon-Signed Rank related measures t-test will determine the impact of within group changes in clinical outcome measures. All statistical analysis was performed using SPSS Statistics (version 22.0, IBM). Statistical significance is set at a priori $p < 0.05$.

RESULTS

A total of 261 patients were admitted to a 3 week residential spines rehabilitation course at DMRC. Twenty-three were excluded from analysis; 20 were unable to complete the course due to exacerbating symptoms or conflicting medically arranged appointments, and 3 patients had incomplete datasets due to input error. Therefore, 238 patients were analysed as part of the clinical service evaluation. The mean duration of symptoms prior to admittance to DMRC was 2 years. Patient descriptive characteristics are reported in table 2. Admission and discharge outcomes are reported in table 3. The prevalence of patients attaining the minimal detectable change (MDC) values for each outcome measure at discharge are presented as a figure in supplementary file 1, but referred to within the text.

Table 2. Descriptive characteristics of UK military personnel admitted to Defence Medical Rehabilitation (DMRC) for residential rehabilitation. Data presented as mean \pm standard deviation or as number (percentage).

Characteristic	Male (n=199)	Female (n=39)	Total (n=238)
Age (years)	32 \pm 6	34 \pm 7	33 \pm 7
Height (cm)	178 \pm 7	165 \pm 6	176 \pm 9
Body mass (kg)	90.4 \pm 15.2	70.4 \pm 13.0	87.4 \pm 16.5
BMI (kg/m²)	28.4 \pm 4.0	25.8 \pm 4.5	27.8 \pm 4.5
Service branch			
Army	154 (77)	18 (46)	172 (75)
RAF	19 (10)	17 (44)	36 (15)
RN	21 (11)	4 (10)	25 (11)
RM	5 (3)	-	5 (2)
Service rank			
Junior NCO	146 (73)	20 (51)	166 (70)
Senior NCO	43 (22)	9 (23)	52 (22)
Commissioned Officer	10 (5)	10 (26)	20 (8)
Ethnicity			
UK National	164 (82)	39 (100)	203 (85)
Foreign Commonwealth	32 (16)	0 (0)	32 (13)
Gurkha	3 (2)	0 (0)	3 (1)

Abbreviations: BMI = Body Mass Index; RAF = Royal Air Force; RN = Royal Navy; RM = Royal Marines; NCO = Non-Commissioned Officer.

Table 3. Admission and discharge data for all clinical outcome measurement. Data presented as median (95% confidence interval) or as a percentage.

Outcome Measure	Admission	Discharge	Effect Size (<i>r</i>)
Participant Number (n)	238	238	-
Functional			
MSLT (m) †	990 (959 to 1135)	1220 (1130 to 1317)	.34
Sit and reach (mm) †	-113 (-379 to -179)	-30 (-173 to -23)	.31
Pain and disability			
TSK †	40 (40 to 42)	38 (37 to 39)	.31
≤37 (%)	27	45	-
>37 (%)	73	54	-
ODI (%) †	38 (37 to 41)	34 (34 to 38)	.17
Mild disability (0-20)	7	16	-
Moderate disability (21-40)	47	46	-
Severe Disability (41-60)	40	34	-
Crippled (61-80)	6	4	-
Bed-bound (81-100)	0	0	-
BPI interference †	5.1 (4.8 to 5.4)	4.4 (4.0 to 4.7)	.25
BPI intensity	4.8 (4.4 to 4.9)	4.8 (4.3 to 4.8)	.04
Psychosocial			
Depression - PHQ9 †	8.0 (8.0 to 9.7)	6.0 (6.7 to 8.3)	.22
<5 No Symptoms	29	36	-
>10 Moderate	43	29	-
>15 Severe	20	13	-
Anxiety - GAD7 *	7.0 (6.8 to 8.3)	6.0 (5.9 to 7.3)	.14
<5 No Symptoms	33	42	-
>10 Moderate	34	26	-
>15 Severe	11	9	-

Abbreviations: TSK = Tampa Scale of Kinesiophobia, ODI = Oswestry Disability Index, BPI = Brief Pain Inventory, PHQ-9 = Patient Health Questionnaire, GAD-7 = General Anxiety Disorder. *signifies a level of significance $P < 0.05$, †signifies $P < 0.001$. Effect size criteria: small: >0.1 , moderate: >0.3 , large >0.5 .

Functional Measures

There was a significant moderate effect ($r = 0.34$) improvement in MSLT distance ($Z = 6.94$, $p < 0.001$) during the 3 week admission. Due to appointment priorities, three patients did not complete the MSLT on admission, and 19 patients did not complete the MSLT at discharge. One hundred and thirty-three patients (64%) improved their MSLT distance by greater than 76 metres (the clinically recognised MDC: see supplementary file 1), 44 patients (21%) decreased their walk/run distance, and 6 patients (3%) distance had not changed at discharge. There was significant moderate effect ($r = 0.31$) improvement in the sit and reach test ($p < 0.05$). Nine patients (4%) did not complete sit and reach at discharge due to availability difficulties regarding appointments. One hundred and seventy-five patients (76%) improved their sit-and-reach ability, 49 patients (21%) reduced their score and (2%) did not change at discharge.

Reported Pain and Disability

There was a significant moderate effect ($r = 0.31$) improvement in TSK scores between admission and discharge ($Z = -6.07$, $p < 0.001$). On admission 173 (73%) scored > 37 indicating a presence of kinesiophobia, at discharge this reduced to 129 patients (54%) At discharge, there was an increased prevalence of patients reporting lower levels of disability using ODI (admission: 55% scored < 40 , discharge 62% < 40) There were significant small effect size ($r = 0.25$) improvement in BPI Lifestyle ($Z = -5.34$, $p < 0.001$), however no differences in BPI Pain score ($Z = -1.24$, $p > 0.05$) were demonstrated at discharge.

Psychosocial Measures

There were significant small effect size improvement in GAD-7 ($Z = -2.45$, $p < 0.001$) and PHQ-9 ($Z = -4.86$, $p < 0.05$) during the admission. At discharge, the prevalence of patients reporting \geq moderate symptoms of anxiety and depression decreased from 33% to 26% and 43% to 29%, respectively

DISCUSSION

This is the first study to investigate the functional and psychosocial outcomes of persistent NSLBP in UK military personnel using a CFT based intervention. Following a 3 week multidisciplinary residential rehabilitation programme, patients made significant favourable changes in functional and psychosocial outcome measures, but pain severity did not change. These findings are not consistent with other CFT-based studies[7, 8]. O'Sullivan et al[7] reported significant reductions in patient reported pain intensity, however found no increase in physical activity measured by total daily steps. The differences in functional outcomes between our studies may be due to the disparities in exposed/prescribed training load, length

of intervention and the treatment environment. Residential multidisciplinary rehabilitation at DMRC involves up to 25 hours of timetabled exercise rehabilitation per week, whereas the O'Sullivan et al[7] exposed participants to 1 to 2 hours outpatient rehabilitation per week, over a 6 to 12 week duration. It's also important to note that O'Sullivan et al[7] excluded participants who presented with spinal stenosis, spondylolisthesis, neurological/motor deficiencies, or had received a pain intervention such as facet joint injection. These conditions were included in our study, which may indicate a nociceptive driver but not the extent of disability or level of disability belief.

Vibe-Fersum et al[8] investigated CFT and manual therapy versus exercise therapy in NSLBP patients over 12 weeks. Like O'Sullivan et al[7], their CFT-based intervention demonstrated superior clinical responses compared with conventional exercise treatment, but they both achieved significant reductions in pain intensity ($p < 0.01$). The differences in pain related outcomes between our studies could be explained by the presence of psychosocial factors. Previous research has demonstrated depression as the strongest predictor of LBP[17]. Vibe-Fersum et al[8] reported 'no symptoms' of anxiety or depression using the Hopkins Symptoms checklist. Although we used a different measurement tool, 41% and 34% of our patients reported \geq moderate symptoms of depression and anxiety on admission, respectively. It is therefore possible that the difference in reported pain lifestyle interference between our studies could be a consequence of psychosocial pain drivers.

Identifying and treating the nociceptive driver can be effective in an acute-or sub-acute presentation, where the source of back pain is typically injuries to soft tissues, mechanical loading, or structural compromise including spinal canal stenosis or herniated discs. However, evidence suggests that a combination of factors contribute to the vicious cycle of pain and persistence of pain. Physical factors including maladaptive movement patterns, pain behaviours and muscle guarding[18], cognitive factors such as depression, fear-avoidance, catastrophising, anxiety, and stress[19] as well as lifestyle factors such as activity levels[20] and sleep[21] have been identified as predictors and contributors to persistent LBP. Addressing nociceptive drivers alone beyond the subacute stage of rehabilitation is unlikely to improve outcomes.

The significant improvements in function and kinesiophobia scores reported in our study are similar to previous literature using cognition-based functional interventions for the treatment of LBP[7, 8, 22]. Vlaeyen et al[22] investigated the effect of a 4 week cognitive-behavioural exercise program followed by 4 week general exercise block, compared with the same interventions in the reverse order. The similarities to our intervention include length of intervention, systematic desensitization and reconceptualising common activities (bending, lifting, and sitting) are safe to do so without ergonomically modifying posture in line with common 'back school' instruction, which may augment the present fear of movement or pain related fear. Vlaeyen[22] reported comparable reductions in kinesiophobia, pain vigilance, and perceived disability following the cognitive-behavioural graded exercise that was not evident when general exercise was completed first. Contrary to the findings of the present study they also demonstrated that pain intensity was significantly reduced within a 4 week period following the cognitive-behavioural graded exercise. Making direct comparisons

between this study and ours must be done with caution though as they used stricter participant exclusion criteria and a much smaller sample size ($n = 6$) with limited details of the intervention used.

Spinal flexion is commonly feared and avoided in low back pain populations[23] and evidence suggests there may be an interaction between reported TSK score (kinesiophobia) and sit and reach ability. A change in this movement, over 2 weeks in the absence of an exercise intervention cannot be accounted for by physiological changes, it is more likely the neurophysiology education aided the patient in reconceptualising pain benefitting from less fear and guarded behaviour and thus more unrestricted movement. Due to study design, we are unable to determine which component of our MDT programme had the greatest effect on sit and reach performance, but it is likely a combination of physiological adaptations in addition to behavioural change facilitating improved TSK outcomes.

The clinical significance of improving ambulatory function and psychosocial health in patients with persistent chronic LBP after 3 weeks should not be underestimated. Improvements in ambulatory performance are a primary aim of all musculoskeletal rehabilitation programmes and an essential component when considering return to duty requirements. Patients with persistent musculoskeletal pain, anxiety, pain related fear, stress, and frustration provoke the same network of neurones within the central nervous system responsible for the perceptual experience of mechanical tissue damage[24]. During the rehabilitation programme, it is intended that a patient will be exposed to previously painful functional activities that they are fearful of or avoidant towards, without an aversive outcome, which is believed to be effective in the reduction of memory traces of pain and fear[25]. Considering the participation in residential rehabilitation and subsequent increase in functional ability, the absence of increased pain intensity is of clinical value, particularly as those patients seen in our service are already non-responders to initial rehabilitation input at primary care level.

The study had several limitations. The objective of this prospective observational service evaluation was to perform a quality assurance exercise; thus, we were unable to include a control group to assess the effectiveness of the intervention or extend data collection over a longer follow-up period. Clinically, it would be useful to understand how and if pain severity changes over time as a result of the CFT-based intervention. Performing a randomised control trial would provide greater insight into the effectiveness of this CFT-based intervention against other treatment options. Whilst the rehabilitation programme was underpinned by best practice guidelines, the delivery of treatment and measurement of outcomes were performed by multiple clinicians. The accuracy of our results may have been heightened had we standardised treatment and testing by using a smaller number of clinicians delivering the intervention and only used one assessor. However, by allowing multiple clinicians to treat and measure outcomes increases the external validity as this evaluation represents a busy 'real world' clinical environment.

CONCLUSION

The findings from this study demonstrate that a 3 week individualised CFT-based MDT rehabilitation programme improves multiple functional and psychosocial outcomes in UK military personnel with chronic LBP. Key findings include significant improvements in patient reported disability, kinesiophobia, anxiety, depression, lifestyle interference, and functional performance with no significant changes in patient reported pain intensity. Although not directly measured, the improvements in clinical outcomes demonstrated are indicative of greater integration of military personnel returning to duty or back to society.

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Data Availability Statement

Data is openly available, but due to privacy concerns, some data regarding participants are available only to bona fide researchers working on a related project, subject to the completion of a non-disclosure agreement. Access requests for any restricted data should be sent to Peter.Ladlow100@mod.gov.uk

Author Contributions

JF and PL conceived the study design. JF managed data collection. DC performed the data analysis. All authors analysed and interpreted the findings. DC wrote the draft manuscript. All authors read, critically reviewed and approved the final version.

Figure 1. UK Military Rehabilitation Care Pathway for individuals with back pain.

Abbreviations: PCRf = primary care rehabilitation facility, RRU = regional rehabilitation unit, MIAC = multidisciplinary injury assessment clinic.

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